DEVELOPMENT OF AUTOMATIC RAIN DETECTOR THROUGH AUTO-REDIAL GSM VOICE ALERT

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Abstract

The quest for choice of convenience has been a great concern for man. This has grossly increased the number of devices manufactured nowadays to protect most equipment from hazards. This paper presents modelling and implementation of an Automatic Rain Detector using a mobile phone, with the goal of automatically detecting rain by buzzing alarm and sending an alert to the owner through a mobile phone. The circuit was modeled with analog components such as Monostable multi-vibrator, capacitors, resistors and GT-E1105F *phone. It was simulated using Pspice simulating software, thus validating the dynamics of the system. The replica of the circuit was practically implemented for real application and the result obtained showed positive response of the system. It is user friendly, efficient and cost effective for public consumption.*

Keywords: *Alarm, Alert, Model, Phone, Rain.*

1.0 Introduction

Currently, customers demand various features in their usage goods, the automation of such different facilities available with that particular device can yield a lot of positive results. For equipment safety, versatile and good device are essential, innovation in engineering and technology have made equipment last longer because an exposure of vital machine to rain at a fraction of one second sometimes can cause a major deterioration.Automatic rain detector is one of the devices which can serve as a tool to save guard these types of equipment especially for automatic wiper control in power windows of a car, also in irrigation system which makes the system to shut down in the event of rainfall, while for the former, protect the internal of an automobile. Automatic rain detector is based on resistive rain sensor with a wide range of output, which developed using electrical and mathematical model. This rain sensor has a predetermined geometry which makes rain water forms a film on the sensor surface causing its resistance to change non-linearly. Further, as this system was implemented without micro-controller and the system works satisfactorily.

The features of the Automatic Rain Detector are:

- Energizing the buzzer when it begins to rain
- Calling the user when it begins to rain
- Shut down the window or irrigation system
- Easily interfaced with power windows and modern irrigation system.

Summarily, it provides safety to the driver and passengers by eliminating the distraction of having to close the windows normally by pressing switches, ditto to irrigation system.

2.0 Review of Related Works

In 1750 (Hocking) introduced the earliest instruments used to monitor weather which involved the sensor of the human body especially sight touch (feel), smell and hearing. The earliest instrument was simple, while the real studies started in 1800's which led to the development of thermometer and wind vane through the work of Glaisher and Belle (1809) and James (1868). Rain detection can be through capacitance and resistance, resistance sensing type, using electrodes deposited on the external surface of the wind - shield was discussed by Berberich R.(1998) in which it was concluded that electrodes are subjected to wear. Similarly Ucar etal (2001) used a grid sensor to detect a resistance change togetherness with Op-Amps for signal conditioning, however the circuits prone to noise for the capacitive sensing. Wilson etal (1989) and Alexander etal (2010) discussed and concluded that the capacitive sensing method relies on the relatively large dielectric constant of water as it affects the capacitance between the electrodes. Furthermore, they are affected by human touch giving a false output.

3.0 Materials and Method

3.1 Components used

- **5Resistors;**
  R_1 15K ¼ watt, R_2 15k ¼ watt,R_3 10K ¼ watt, R_4 58k¼ watt, R_5 120k ¼ watt,
- **2Capacitors**
  C_1 100uF, C_2 47uF,
- **4 Diodes**
  IN 4148 for D1, D_2, D_3, D_4
- **Regulator**
  I.C. Regulator = Lm317
- **2 Transistors**
  BC139Q1 (N-P-N), BC 337Q2 (P-N-P)
- **1 Regulator**
  IM 358
- **2 Timer**
  NE555
- **1BUZI-BUZZER**
- **2 Switches**
  SP2S & SPDF
- **1 Mobile Phone**
  Samsung Mobile Phone GT-E1105F
- **1 6v 4.5 AH battery**
- **Water Sensor** (Resistive and Capacitive)

3.2 System Design

Transformation

E= Induced voltage = 230V a.c

$$\text{Voltage per turn (VT)} = E/N = 1.44f\Phi m \quad (1)$$

By applying "r" factor where "r"=$\frac{Magneticloading}{Electricloading}$

Power= E x Im x 10^{-3}, Where Im = maximum current (for the stipulated rating)

$$I = \frac{Qm}{rN} \quad (2)$$

Substitute from Equation (1) and (2)

$$¢= P \times \frac{10^{3r}}{1.44f}$$

$$Vt = 1.44f \times r \times \frac{10^3}{1.44f}$$

$$\text{By putting } c = \sqrt{1.44frX10^3}$$

$$Vt = \sqrt{1.44 frX10^3 XP}$$

$$Vt = Cp$$

For distribution transformer, the value of C is between 0.35 and 0.45, but we decided to choose the average value i.e $C = \frac{0.35+0.45}{2}$

Given Vt = 0.16 volt per turn, and N_1 = 1375 turns

$$P = E \times Im \times 10^{-3}$$

Then, $Im = 0.130A = 130mA$

Proposed rating;

Voltage rating 220/40r.m.s ,

Current rating: 150mA,

Supply frequency: 50Hz

S.W.G. for secondary =18

Giving $\frac{Vs}{Vp} = \frac{Ip}{Is} = \frac{50}{220} = \frac{1.4}{Is}$: Is = 6.16A

Ns = 313 and Np =1375

For the rectification, the bridge rectifier of the following specification was employed

- Peak reverse voltage (Vr = 75) of 25^0C with 10VA leakage
- Reverse leakage current (I_R = 50A) at 100^0C ambient temp.
- diode voltage dropVf = 1.5 max operating temperature at Tc = 120^0C

The output D.C. voltage from the rectifier

$$Vd.c = (50 – 1.5)\ v = 48.5v$$

Using shunt input capacitor (Electrolytic capacitor C_1, C_2) for full wave rectification

$$Vd.c. = Vm - \frac{Id.c.}{4fc} \quad (3)$$

$$Vm = \sqrt{2}Vr.m.s \quad (4)$$

$$Vd.c = \frac{2rm}{\pi} \quad (5)$$

Giving V.r.m.s = 50V, I.r.m.s = 4.4A

Then, $Vm = \sqrt{2} \times \sqrt{50}\ 70.71V$

$$Im = \sqrt{2} \times 4.4 = 6.22A$$

$$Vd.c = \frac{2 \times 70.71}{3.142} = 4.5V$$

$$Id.c = \frac{2 \times 6.22}{3.142} = 3.961A$$

With F = 50 Hz

$$C = \frac{Id.c}{4f(Vm - Vd.c)} \quad (6)$$

$$C = \frac{3.961}{4 \times 50(70.71 - 4.5)}$$

$$C = 770\mu F$$

The prefer chosen value = 500μF, 60V

Incoming signal was regulated with I.C. Regulator = Lm317 (Adjustable regulator), with test current of 4.4A and power rating of 40w, tolerance = 1.25r, max. Temperature of150^0C, output voltage of 9V

R_{out} = 2700Ω

While R_{adj} = variable resistor

$$V_{out} = 1.25 = 1 + \{\frac{Rout}{1!Radj}\}$$

$$40 = 1.25\,\frac{(1+270)}{Radj}$$

$R_{adj} = 8.7k$

$R_{adj} = 10k$

10k variable resistor was preferred

For triggering of the device, the frequency of the oscillation is given by

$$F\,(Hz) = \frac{1}{0.69(R1\;C1 + R2C2)} \quad (7)$$

So the approximate frequency of 1 KHz gave a pleasing tone

i.e $F = 1/T = 1.44/\{(R_1 + R_2 \times 2) \times C\}$

The low time from each pulse was given by

$T_L = 0.693 \times R_2 \times C = \{0.693 \times 15 \times 14\} = 140.3$

The high time from each pulse is given by

$T_H = 0.693 \times (R_1 + R_2) \times C$

$= 0.693 \times 15 + 15 \times 17 \times 10^{-6} = 291.06$

For D = Duty circle = $(R_1 + R_2) / (R_1 + 2 \times R_2)$ (8)

$= (15 + 15) / (15 + 2 \times 15) = 0.667$

If the entire circuit (Fig1) is symmetrical (for equal mark and space C_1R_1 and C_2R_2)

Period time $T = 0.69(C_1R_2 + C_1R_1)$

$F = \frac{1}{T} = 1.44 / (R_1 + R_2 \times 2) \times 17 \times 10^{-6}$

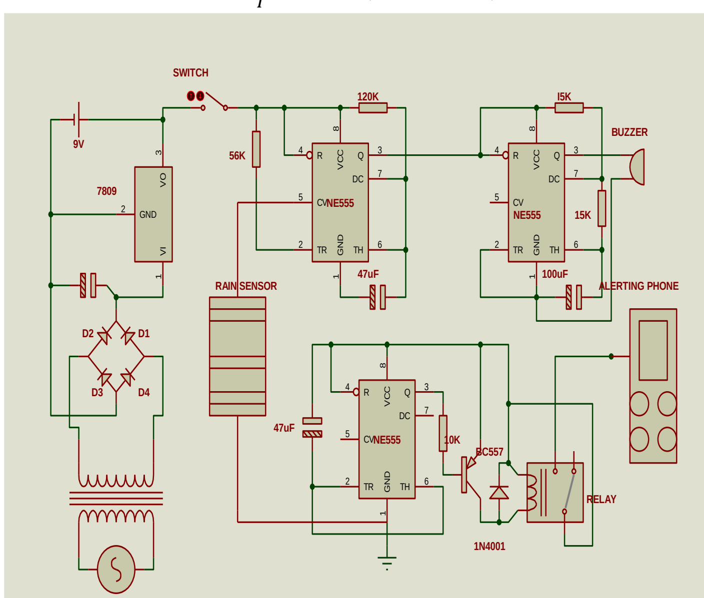

Fig1: Circuit Diagram of Automatic Rain Detector

For the Feedback Detector Circuit, it was built around a monostable multivibrator and set for a period of 3 seconds.

$$T_d = 1.1R_bC_b(8)$$

$$Choosing C = 4.7\mu F, R_b = 58k\Omega$$

F =14 kHz

The Samsung CE 0168 with model number GT - E 1105F used for interfacing was configured with the following mode at Auto – Redial and Voice Server Mode

Auto-Redial Mode

Click

- Menu
- Setting
- Application
- Call
- Voice call
- Auto – Redial
- ON

Voice Server Mode

Click

- Menu
- Phonebook
- Favourite
- Voice Server

Enter

- Voice Server Name
- Voice server Number

Through this, it could be customized for the user.

The equivalent electrical model for the sensor is given

$$R = \frac{Pl}{A} \quad (9)$$

Where R is the resistance of the sensor, P is resistivity, l is the length and A is the surface of rain drop

4.0 Results and Discussion

The simulating results by the pspice (proteus) demonstrated the earlier workability of the model, which aided the quick implementation of the circuit. 555timer linearised the sensor and served as a tool for the sensitivity of the design. The result shown that the sensor used has a wide range of output, as the rain intensity increases, its resistance changes.The performance of the system is tested on a vehiclean irrigation model. And the Lab. experimentation carried outusing distilled water and a standard water dropper toobtain sensor characteristics was quite satisfactory. The effectiveness of IC555 in linearising the sensor response was demonstrated.Further, it was found that external unwanted touchor abrasion does not affect the system negatively.Also the system was observed to show consistentlyreliable response, so that in future we will be able to control the wiper motorcontinuously by using proportional integral controller.

5.0 Conclusion and Recommendations

In this work, attempt had been made to design and implement an electronic rain detector. This device is quite cheap and durable, also gives room for further development. However, it is highly necessary to explore the usage of electrical card tool for initial test bed before final implementation so as to adjust the resistance and capacitance effect which may reduce the efficiency of any design.

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